

What is claimed is:

1. A method for forming copper interconnection conductors for interconnecting integrated circuits on a substrate, comprising the steps of;
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forming a barrier layer using ruthenium (Ru) or rhenium (Re) or their alloys on the surface of an insulation layer on said substrate by using an atomic layer deposition (ALD) method, and

forming a copper layer on top of said barrier layer.

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2. The method of claim 1, wherein said ruthenium (Ru) alloys contain an atomic ratio of at least 50% or more of ruthenium (Ru).

3. The method of claim 1, wherein in place of said atomic layer deposition method, a plasma-enhanced atomic layer deposition (PEALD) method is used.
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4. The method of claim 1, wherein said copper layer of thin film is formed using a chemical vapor deposition (CVD) method.

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5. The method of claim 1, wherein said copper layer of thin film is formed using a chemical vapor deposition method with a treatment of iodine or iodine compound as a catalyst.

6. The method of claim 1, wherein said copper layer of thin film is formed by using an electroplating method.
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7. The method of claim 1, wherein said copper layer of thin film is formed by using a chemical vapor deposition method and an electroplating method.
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8. The method of claim 1, wherein rhenium (Re) or rhenium alloys are used in place of ruthenium (Ru) or ruthenium alloys.

5 9. The method of claim 8, wherein said rhenium alloys contain an atomic ratio of at least 50% or more of rhenium.

10 10. A method for forming copper interconnection conductors for interconnecting integrated circuits on a substrate, comprising the steps of;

forming a barrier layer on the surface of a patterned insulation layer on a substrate,

15 forming an adhesion layer on said barrier layer using ruthenium (Ru) or ruthenium alloys by using an atomic layer deposition method, and

forming a copper layer of thin film on the surface of said adhesion layer.

20 11. The method of claim 10, wherein said barrier layer is formed using one of the materials including TiN, Ta, TaN, TaNC, WN, WNC, Ti-Si-N. and Ta-Si-N.

25 12. The method of claim 10, wherein said ruthenium (Ru) alloys contain an atomic ratio of at least 50% or more of ruthenium.

13. The method of claim 10, wherein in place of said atomic layer deposition method, a plasma-enhanced atomic layer deposition method is used.

30 14. The method of claim 10, wherein said copper layer of thin film

is formed using a chemical vapor deposition (CVD) method.

15 15. The method of claim 10, wherein said copper layer of thin film is formed using a chemical vapor deposition method with a treatment of iodine or iodine compound as a catalyst.

16. The method of claim 10, wherein said copper layer of thin film is formed by using an electroplating method.

10 17. The method of claim 10, wherein said copper layer of thin film is formed by using a chemical vapor deposition method and an electroplating method.

15 18. The method of claim 10, wherein rhenium (Re) or rhenium alloys are used in place of ruthenium (Ru) or ruthenium alloys.

19. The method of claim 18, wherein said rhenium alloys contain an atomic ratio of at least 50% or more of rhenium.

20 20. The method of claim 10, wherein in place of ruthenium (Ru) or ruthenium alloys, one of the materials including nickel (Ni), platinum (Pt), osmium (Os), iridium (Ir) or their alloys of said each metal is used for forming a barrier layer.